Scientific Approach of the Harmony in the Built Environment

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Abstract: *In this work, the phenomena of the harmony in the built environment is investigated. Our initial point is, that the harmony is dominate in the nature. We apply these regularities to the constructed environment. So we can tell statements to the harmonics of the built environment with scientific approach. In our analysis we reach the scaling law, the scale invariance, the symmetry, as the concepts related to the harmony.*

Keywords*: harmony, built environment, scaling law, color, pattern*

1 Introduction

First of all, there are some questions come up: What does it mean "harmony"? Is this definition analog with the beauty? It is a hard task to give a definition to the environmental harmony, but it is easy to describe about its phenomena. We define as a harmonious environment, where we feel good ourselves. The harmonious environmental is related with the ecological built environment [1,2]. We find some analogies in the arts, for this intuition. Beautiful and harmonious is a painting, which is good to see, and its sight delight us. Similarly, beautiful and harmonious is a musical composition, which is good to hear, and during this, we can relax.

In case of a painting, the harmony among the colors is very important. It is an old observation, scale like arranged colors give us harmonic impression. For example one possible scale is the same hue, but different brightness colors attached to each other [3]. In the music, the situation is similar. It should be to create the harmony between the sounds, where the scale became an important role. In the painting, the situation is a little bit complicated, because not only the colors, but the pattern and its sizes have its significance also.

My former professor Károly Simonyi, in one of the lectures of Theoretical Electricity, asked the students: „ Dear colleagues, what is a similarity between the Maxwell equations and a gothic cathedral?". He did not wait the surprised students to retrieve from the astonishment, he immediately answered: "The beauty is the same in these things." The first thing, which stands out is the symmetry. The eletrical and the magnetic field behave symmetrical [4]. Similarly, the gothic cathedral also symmetrical. If we examine the details more precisely, we realise, that the symmetry is not perfect. For example, that there is an electrical monopole, but magnetic monopole is not exists. Similar symmetry violation are observable at the gothic cathedrals. For example the rotating rosettes have not mirror symmetry, but have shift symmetry.

In nature, we can meet many scale invariant objects. So objects are clouds, the shoreline of continents, branches of the woods. The scale invariant means, if we enlarge the little part of the whole object, the enlargement will have the similar character, as the original whole object. This behaviour is also observable on the buildings, but the settlement networks show this pattern too.

In the present work, we will examine the built environment, based on the three mentioned properties. Namely, from the viewpoint of the scaling law, symmetry and also the scale invariance.

2 Scaling concept

In the nature, there are scale dependent and independet phenomenon and patterns as well. Some properties are dependent from the characteristic length in different ways, Some examples from the biology: that's why, that the grasshopper jump more higher compared to its size, than the panther. An ant endure more bigger fall (compared to its size), than an elephant. In the physics, we can find also examples. The gravity is basically an extremely weak interaction. It is much weaker, than the Coulomb interaction. Despite this, in case of large masses, it is a very dominant force. Its an unique interaction, in case of the describing the motion of our solar system. If we reduce the size, the relevance of gravitational force is decrease. In the world of nano-sized objects, the gravity is negligible. In this size range, the importance of the very weak Van der Waals interaction is more bigger. The reason of this, is the interactions are dependent from the characteristic length in different ways [5].

In the built environment, there are such patterns also, which are not grow automatically with the growing of the object size. Mostly the sizes of the doors and the windows changes only in a certain size range. The door scale of a little and big house essentially is the same. This dimensions is defined by the function and the human size. The sizes of the stairsteps are also such thing. A house can

not be enlarge proportionally. If the architect does not take care for this, then the buildings will be unproportional.

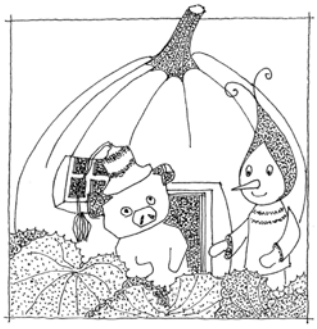

FIGURE 1. Part from a yarn. The house from vegetable marrow works in small size only. The crops show mostly scale invariance.

The trees and their branches are tipically scale invariant objects. A small tree and a big one looks approximately the same from far viewpoint. But the leaves are not scale invariant. The leaves of a large nut tree are not bigger, than the smaller one. In this context, the difference is, that there are more leaves in the big walnut tree than the smaller wood. It is true in case of fruits and crops. Approximately, in a large apple tree there are same sized apples, than the smaller one. But in the former one yields more apples. So, the crops are tipically not scale invariant objects. Here, must be mentioned, that there is an architectural trend, which is try to form a house, from enlarged crop-shape.

3 Scaling invariance

There are some patterns in the nature, showing identical characteristic, independently from the magnification. These objects already mentioned in the introductions, such as coastline, clouds, branches of the trees, corals etc.. But self similar patterns are also observable in various surfaces. For example the growth front of the epitaxial layer growth and the surface morphology after electrochemical etching [6]. These patterns are decribed in a mathematical form of self affin and fractal formalism as well. They are characterized by fractured dimension. Determination of this directly in case of exact geometry, or by box counting method in case of statistical size and shape . Here is a remark: Who has not been built castle or town in the sand box in his childhood? Most of the children make small trees made from branching twigs next to small cars and toy manikins. He insert these to the sand, as if it would be a wood. The children also instinctively senses, that the small broken part of the wood similar to the whole

tree. The focus is on the sense. It is not necessary to know the scientific background, that the people use perfect the tings related to scale.

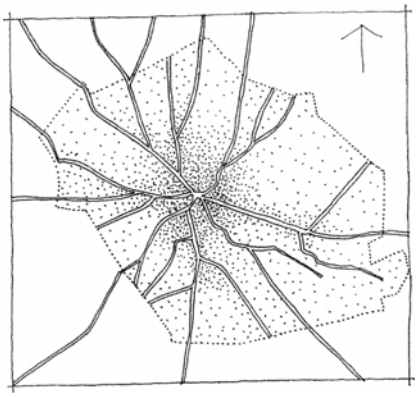

FIGURE 2. Significant streets of the town Abony, in Hungary. The network of the city can show fractal-like structure.

It is often observable the recurrence of the same kind of pattern and shape on the buildings. These take coherent the different parts of the building. So this feature is make the building mostly consistent, harmonious and beautiful. We can also observe fractal like patterns at the settlement networks [7]. This kind of street layout primarily the particularity of the developing in natural way of settlements. It is responsive to the relation of the nature encompass the settlement evenly and in the shortest route. So this feature take the street layout expedient and ecologically. In case of planned parts of the city the chess like order is discernible. The settlements, developing in the synergistic manner, this pattern is not observable.

4 Symmetry concept

The symmetry is very frequent in the nature. The inflorescence of the plants also very common symmetric. In most cases they are rotationally symmetric, but there is mirror symmetric and shift symmetric inflorescence also exists. In case of the animals the axial symmetry is common. The insects and the mammals are symmetric to the axis of the moving direction, but there are some exeptions. The human body and the face are axial symmetric as well. There is also lot of symmetry in the physics. It is only enough to think to the crystal structures. But this can be found in case of elementary particles. A good example is the electron - positron pair. But the electomagnetic fields mentioned in the introduction also shows symmetry. The change of the electric field creates magnetic field and vice versa. So the change of the magnetic field creates electric field. The above

mentioned symmetries are true only in roughly. We mentioned the symmetry break of the electric field. But neither the above mentioned matter - antimatter pairs are symmetric, because according to our present knowledge, there is significant quantitative difference between their amount. This is valid for the biological symmetries as well. But there are not perfect symmetries. Think about our internal organs.

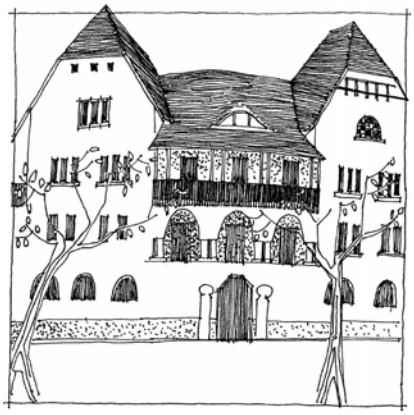

FIGURE 3. A typical buliding in the Wekerle district, in Budapest. Imperfect symmetry has aesthetical value.

The symmetry has relation with the beauty. A beautiful women's face delight. We think its rhumb perfect. Prepare a nice face to face picture about her face. Bisect this picture in the line of the nose. Create a perfect axial symmetry image with the help of the left or right side. The faces generated from the two sides we did not find as good as the original. So the perfect symmetry is not a condition of the beauty and the harmony.

The bridges and other engineering designs are mostly symmetrical. The reason of this symmetry is the expediency. It is envicible, that the condition of the optimal solution is not the perfect symmetry. This pursuit for the breaking of the symmetry can be found in the architecture. The small details in broadly symmetric buildings are not symmetric. We found these more beautiful, than the perfectly symmetrical ones. The houses of the "socialist housing" estate have the same shape and mostly their distances are also the same, so they have shift symmetry. The residents often complained that they did loose themselves. They wanted to go other's flat. Today try to make these houses slightly different with colours and plants. Recently, the rowhouses are compiled from not exactly the same units. It is not only beautiful, but it is more appropriate as well.

Acknowledgement

This work is supported by the COST grant of C24 and TU1104.

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